REMARKS

Reconsideration of the above-identified application is respectfully requested. Claims 1-23 are currently pending. Claims 1-13, 19 and 20 have been amended. Claims 17 and 18 have been canceled without prejudice or disclaimer. The specification has been amended to correct typographical errors in two instances, both of which would be readily apparent to one of ordinary skill in the art (see, e.g., Fig. 12 regarding the change to page 12 of the specification). The paragraph bridging pages 10 and 11 of the specification has also been amended to correct minor typographical errors and to provide explicit antecedent basis for the subject matter of claim 20, support for which may be found at least in originally filed claim 20. The Examiner's indication of allowable subject matter in claims 5-7, 9-11 and 18-19 is acknowledged with appreciation.

The Office Action includes a rejection of claims 5-7, 9-11 and 17-19 under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite. Claims 17 and 18 have been canceled. As noted by the Examiner "carrier barrier layer" in claim 17 was intended to be "carrier blocking layer". The correct terminology is reflected in claim 19, which depended from claim 17 and which has been placed in independent form. The correct terminology is also reflected in claim 12, which now recites subject matter from claim 18, claim 18 having been canceled. With regard to claims 5-7, 9-11, 18 and 19, it is believed that one of ordinary skill in the art would readily understand what is being claimed. Nevertheless, in an effort to expedite prosecution, claims 5-7 and 9-11, and 19 have been amended in a manner that addresses the Office's rejection and have been placed in independent form to gain allowance. Claim 19 has been further amended for readability

and to change "n-type electrode" and "p-type electrode" to "first electrode" and "second electrode", respectively, for reasons unrelated to patentability. The changes to claims 5-7, 9-11 and 19 are not intended to narrow the scopes of the affected claim elements. Withdrawal of the rejection, and allowance of claims 5-7, 9-11 and 19 are respectfully requested.

The Office Action also includes a rejection of claims 12-14 and 21-22 under 35 U.S.C. § 102(e) as allegedly being anticipated by the Hatakoshi et al. patent (U.S. Patent No. 6,400,742). Independent claim 12 has been amended to incorporate the subject matter of claim 18, which was indicated as being allowable. In this regard, the language taken from claim 18 has been amended in a manner similar to that of claim 19 as described above. For example, claim 12 has been amended to change "n-type electrode" and "p-type electrode" to "first electrode" and "second electrode", respectively, for reasons unrelated to patentability. In addition, the language placed in claim 12 from claim 18 has been amended in a manner that addresses the Office's 35 U.S.C. § 122, second paragraph, rejection with regard to claim 17. Allowance of claim 12 is respectfully requested.

Claims 13-23 depend from claim 12 and are therefore allowable at least by virtue of dependency. Allowance of claims 13-23 is respectfully requested. It is noted that claim 13 has been amended to conform to claim 12 and that claim 20 has been amended for readability. These changes are not intended to be related to patentability or to narrow the scope of the affected claim elements.

The Office Action also includes a rejection of claims 15, 16 and 23 under 35 U.S.C. § 103(a) as allegedly being unpatentable over the Hatakoshi et al. patent. As noted above,

claims 15, 16 and 23 depend from claim 12 are therefore allowable at least by virtue of dependency. Withdrawal of the rejection and allowance of claim 15, 16 and 23 are respectfully requested.

The Office Action also includes a rejection of claim 17 under 35 U.S.C. § 103(a) as allegedly being unpatentable over the Hatakoshi et al. patent in view of the Shimizu et al. patent (U.S. Patent No. 5,583,878) and a rejection of claim 20 under 35 U.S.C. § 103(a) as allegedly being unpatentable over the Hatakoshi et al. patent in view of the Shimizu et al. patent as applied to claim 17, and further in view of the Nagahama et al. patent (U.S. Patent No. 6,172,382). As noted above, claims 17 and 20 depend from claim 12 and are therefore allowable at least by virtue of dependency. Accordingly, no further discussion of the substance of the rejection is warranted. Applicants do not concede, however, that the Office's combination of the above-noted references is proper. Withdrawal of the rejection and allowance of claims 17 and 20 are respectfully requested.

The Office Action also includes a rejection of claims 1-4 and 8 under 35 U.S.C. § 103(a) as allegedly being unpatentable over the Nagahama et al. patent. Independent claims 1, 4 and 8 have been amended, and Applicants respectfully submit that claims 1, 4 and 8 are patentable over the Nagahama et al. patent.

In addition to reciting, *inter alia*, an active layer and multi-quantum barrier layers as set forth in these claims, independent claims 1, 4 and 8 have been amended to further recite first and second light waveguide layers and first and second cladding layers. The active layer and the multi-quantum barrier layers are disposed between the first and second light waveguide layers, and the first and second light waveguide layers are disposed between the

first and second cladding layers. In other words, the claimed multi-quantum barrier layers are different from the claimed cladding layers and waveguide layers.

In contrast, the Nagahama et al. patent does not disclose an arrangement of layers as recited in claims 1, 4 and 8. For example, column 11, lines 25-30 and lines 50-67 of the Nagahama et al. patent cited by the Office disclose a p-type cladding layer that has a superlattice structure, but does not disclose multi-quantum barrier layers disposed between waveguide layers and cladding layers as claimed in claims 1, 4 and 8. Accordingly, claims 1, 4 and 8 are patentable over the Nagahama et al. patent for at least this reason. Withdrawal of the rejection and allowance of claims 1, 4 and 8 are respectfully requested.

Claims 2 and 3 depend from claim 1. Claim 2 has been amended to conform to claim 1, and claim 3 has been amended for readability. These changes are not intended to narrow the scopes of the affected claim elements. Allowance of claims 2 and 3 is respectfully requested.

In light of the foregoing remarks, withdrawal of the rejections of record and allowance of this application are respectfully requested. Should there be any questions in connection with this application, the undersigned respectfully requests that he be contacted at the number given below.

Respectfully submitted,

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Marked-up Paragraphs of Specification

Paragraph bridging pages 3 and 4:

Preferably, the multi-quantum barrier layer is formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer ($0<x<1$, $0<y\leq1$), so that its energy band can have a multi-quantum barrier structure. In this case, the multi-quantum barrier layer is formed by making the thickness of the $Al_xGa_{1-x}N$ layer of each double layer differ from the thicknesses of the $Al_xGa_{1-x}N$ layers of the other double layers or making the thickness of the $In_yGa_{1-y}N$ layer of each double layer differ from the thicknesses of the $In_yGa_{1-y}N$ layers of the other double layers, thereby making the energy levels of multi-quantum barrier layers differ from each other. Or, the multi-quantum barrier layer is formed by making the value of x for the $Al_xGa_{1-x}N$ layer of each double layer differ from the value of x [fors] of aluminum of the $Al_xGa_{1-x}N$ layers of the other double layers, thereby making the energy levels of multi-quantum barrier layers differ from each other.

Paragraph bridging pages 10 and 11:

Next, an n-type material layer M for generating a laser beam is formed on the substrate. The n-type material layer M consists of an n-type compound semiconductor layer 42, an n-type clad layer 44 and an n-type waveguide layer 46 which are sequentially deposited on the substrate 40. The n-type compound semiconductor layer 42 is made of

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one of III-V group nitride compounds and it is preferably an n-GaN layer. Preferably, the n-type clad layer 44 is an n-$Al_xGa_{1-x}N$ mono-layer (where $0<x\leq0.2$) containing a predetermined percentage of aluminum Al[,]; however, it may be a double layer, such as a supperlattice layer consisting of an AlGaN layer and a GaN layer. Also preferably, the n-type clad layer 44 has a thickness to minimize the loss of light mode in the direction of installation of the substrate 40. For example, the n-type clad layer 44 has a thickness between 0.5 μm and 1.7 μm. At this time, the strain of the entire semiconductor light emitting device must be considered. Thus, it is preferable that the n-type clad layer 44 is thinner than the minimum value of the above thickness range in order to reduce the strain of the entire semiconductor light emitting device. If the n-type clad layer 44 is thickly formed, the loss of light mode to the substrate 40 can be minimized. The n-type waveguide layer 46 is preferably an n-GaN layer which is one of III-V group nitride compound semiconductor layers. An active layer 48 is formed on the n-type material layer M for generating a laser beam and the active layer 48 is preferably a material layer having a multi-quantum well structure. Also preferably, the active layer 48 is III-V group nitride compound semiconductor layer and more preferably it is an InGaN layer containing a predetermined percentage of indium (In). Also, the active layer 48 may be a mono-layer or a double layer described in the first, second and third embodiments and its description will not be repeated here. An electron blocking layer 50 and a p-type waveguide layer 52 are sequentially formed on the active layer 48. At this time, the electron blocking layer 50 is

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preferably an AlGaN layer containing a predetermined percentage of aluminum in order to enhance the electron blocking efficiency[,]; however it may be a multi-quantum barrier layer 5 and 6 described in the first through third embodiments. The p-type waveguide layer 52 has almost the same structure as the n-type waveguide layer 46 except that a p-type doping material is used. Preferably, the p-type waveguide layer 52 has a thickness to get the highest value in light mode and light gain, such as 0.15 μm ~ 0.2 μm. A p-type compound semiconductor layer 54 is formed on the p-type wave layer 52. Preferably, the p-type compound semiconductor layer 54 has almost the same structure as the n-type compound semiconductor layer 42 except that an n-type doping material is used. However, on the p-type compound semiconductor layer 54, a p-type electrode (not shown) is formed, and thus, it is preferable that the p-type compound semiconductor layer 54 has a higher doping concentration than the p-type waveguide layer 52 in order to make its electrical resistance low. <u>For example, the p-type waveguide layer 52 and the p-type compound semiconductor layer 54 can be the same material layer, wherein the doping concentration of the p-type compound semiconductor layer 54 is higher than that of the p-type waveguide layer 52.</u>

Paragraph at page 12, lines 5-15:

FIGS. 12A and 12B are energy band diagrams of material layers constituting a conventional laser diode and a laser diode according to the fourth embodiment of the

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present invention, respectively. Referring to FIGS. 12A and 12B, an energy band E_{nc} of a conventional n-type clad layer has a [greater] smaller width than an energy band E_{nc}' of an n-type clad layer of the present invention. In addition, in FIGS. 12A and 12B, an energy band corresponding to an energy band E_{pc} of a conventional p-type clad layer does not appear next to an energy band E_{eb}' of an electron blocking layer of the present invention corresponding to an energy band E_{eb} of a conventional electron blocking layer. Reference numerals E_{mqw} and E_{mqw}' indicate energy bands of active layers having a conventional multi-quantum well structure and a multi-quantum well structure of the present invention, respectively.

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Marked-up Claims 1-13, 19 and 20

1. (Amended) A nitride semiconductor light emitting device comprising:

an active layer formed of a GaN family compound semiconductor; [and]

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and a GaN layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0 < x < 1$;

a first light waveguide layer and a second light waveguide layer; and

a first cladding layer and a second cladding layer,

wherein the active layer and the multi-quantum barrier layers are disposed between the first and second light waveguide layers, and

wherein the first and second light waveguide layers are disposed between the first and second cladding layers.

2. (Amended) The nitride semiconductor light emitting device of claim 1, [further comprising] wherein the first and second light waveguide layers are GaN light waveguide layers [formed at the upper and lower sides of the active layer or at the upper and lower sides of the multi-quantum barrier layers].

3. (Amended) The nitride semiconductor light emitting device of claim 1, wherein the active layer is formed by depositing a double layer consisting of an $In_xGa_{1-x}N$

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layer and an $Al_yGa_{1-y}N$ layer, a double layer consisting of an $In_xGa_{1-x}N$ layer and an $In_yAl_zGa_{1-y-z}N$ layer, a double layer consisting of an $In_xAs_yGa_{1-x-y}N$ layer and $In_zGa_{1-z}N$ layer or a double layer consisting of an $In_xAs_yGa_{1-x-y}N$ layer and an $Al_yGa_{1-y}N$ layer a predetermined number of times to form a multi-quantum well structure [and at this time], and

wherein $0 \leq x \leq 1$, $0 \leq y < 1$, $0 \leq z < 1$, $x+y < 1$ and $y+z < 1$.

4. (Amended) A nitride semiconductor light emitting device comprising:

an active layer formed of a GaN family compound semiconductor; [and]

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $Al_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0 < x < 1$, $0 \leq y < 1$, and $x > y$;

a first light waveguide layer and a second light waveguide layer; and

a first cladding layer and a second cladding layer,

wherein the active layer and the multi-quantum barrier layers are disposed between the first and second light waveguide layers, and

wherein the first and second light waveguide layers are disposed between the first and second cladding layers.

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5. (Amended) [The] A nitride semiconductor light emitting device [of claim 4,] comprising:

an active layer formed of a GaN family compound semiconductor; and

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $Al_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0<x<1$, $0\leq y<1$, and $x>y$,

wherein [if $0<x<1$, $0\leq y<1$ and $x>y$, the multi-quantum barrier layer is formed by making the thickness of the $Al_xGa_{1-x}N$ layer of each double layer differ from] the thicknesses of the $Al_xGa_{1-x}N$ layers of the [other] double layers differ from each other, thereby making [the] energy levels of the multi-quantum barrier layers differ from each other.

6. (Amended) [The] A nitride semiconductor light emitting device [of claim 4,] comprising:

an active layer formed of a GaN family compound semiconductor; and

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $Al_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0<x<1$, $0\leq y<1$, and $x>y$,

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wherein [if $0 < x < 1$, $0 \le y < 1$ and $x > y$, the multi-quantum barrier layer is formed by making the thickness of the $Al_yGa_{1-y}N$ layer of each double layer differ from] the thicknesses of the $Al_yGa_{1-y}N$ layers of the [other] double layers differ from each other, thereby making [the] energy levels of the multi-quantum barrier layers differ from each other.

7. (Amended) [The] A nitride semiconductor light emitting device [of claim 4,] comprising:

an active layer formed of a GaN family compound semiconductor; and

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $Al_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0 < x < 1$, $0 \le y < 1$, and $x > y$,

wherein [if $0 < x < 1$, $0 \le y < 1$ and $x > y$, the multi-quantum barrier layer is formed by making the value of x for of aluminum of the $Al_xGa_{1-x}N$ layer of each double layer differ from the value] the values of x for the $Al_xGa_{1-x}N$ layers of the [other] double layers differ from each other, thereby making [the] energy levels of the multi-quantum barrier layers differ from each other.

8. (Amended) A nitride semiconductor light emitting device comprising:

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an active layer formed of a GaN family compound semiconductor; [and]

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0<x<1$ and $0<y\leq 1$;

a first light waveguide layer and a second light waveguide layer; and

a first cladding layer and a second cladding layer,

wherein the active layer and the multi-quantum barrier layers are disposed between the first and second light waveguide layers, and

wherein the first and second light waveguide layers are disposed between the first and second cladding layers.

9. (Amended) [The] A nitride semiconductor light emitting device [of claim 8,] comprising:

an active layer formed of a GaN family compound semiconductor; and

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0<x<1$ and $0<y\leq 1$,

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wherein [the multi-quantum barrier layer is formed by making the thickness of the $Al_xGa_{1-x}N$ layer of each double layer differ from] the thicknesses of the $Al_xGa_{1-x}N$ layers of the [other] double layers differ from each other, thereby making [the] energy levels of the multi-quantum barrier layers differ from each other.

10. (Amended) [The] A nitride semiconductor light emitting device [of claim 8,] comprising:

an active layer formed of a GaN family compound semiconductor; and

multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0<x<1$ and $0<y\leq 1$,

wherein [the multi-quantum barrier layer is formed by making the thickness of the $In_yGa_{1-y}N$ layer of each double layer differ from] the thicknesses of the $In_yGa_{1-y}N$ layers of the [other] double layers differ from each other, thereby making [the] energy levels of the multi-quantum barrier layers differ from each other.

11. (Amended) [The] A nitride semiconductor light emitting device [of claim 8,] comprising:

an active layer formed of a GaN family compound semiconductor; and

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multi-quantum barrier layers formed by repeatedly depositing a double layer consisting of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer at least two times, at either the upper or lower side of the active layer, by which an energy band has a multi-quantum barrier structure, wherein $0 < x < 1$ and $0 < y \leq 1$,

wherein [the multi-quantum barrier layer is formed by making the value of x for the $Al_xGa_{1-x}N$ layer of each double layer differ from the value] the values of x for the $Al_xGa_{1-x}N$ layers of the [other] double layers differ from each other, thereby making the energy levels of the multi-quantum barrier layers differ from each other.

12. (Amended) A nitride semiconductor light emitting device comprising:

a substrate;

an active layer formed on the substrate, in which light emission occurs;

an n-type material layer for generating a laser beam [which is], the n-type material layer being formed between the substrate and the active layer and which includes an n-type clad layer for preventing light loss in the direction of installation of the substrate;

a carrier blocking layer, a p-type waveguide layer and a p-type compound semiconductor layer which are sequentially deposited on the active layer; and

[an n-type] a first electrode and a [p-type] second electrode generating a potential difference for diffusion of electrons to the active layer,

wherein the carrier blocking layer is a multi-quantum barrier layer,

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wherein the multi-quantum barrier layer consists of double layers of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer ($0<x<1$, $0<y\leq 1$), and

wherein the thicknesses of the $In_yGa_{1-y}N$ layers of the double layers differ from each other, thereby making energy levels of the multi-quantum barrier layer differ from each other.

13. (Amended) The nitride semiconductor light emitting device of claim 12, wherein the n-type material layer comprises:

an n-type waveguide layer formed between the n-type clad layer and the active layer; and

an n-type compound semiconductor layer formed between the n-type clad layer and the substrate and connected to the [n-type] first electrode.

19. (Amended) [The] A nitride semiconductor light emitting device [of claim 17,] comprising:

a substrate;

an active layer formed on the substrate, in which light emission occurs;

an n-type material layer for generating a laser beam, the n-type material layer being formed between the substrate and the active layer and which includes an n-type clad layer for preventing light loss in the direction of installation of the substrate;

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a carrier blocking layer, a p-type waveguide layer and a p-type compound semiconductor layer which are sequentially deposited on the active layer; and

a first electrode and a second electrode generating a potential difference for diffusion of electrons to the active layer,

wherein the carrier blocking layer is a multi-quantum barrier layer, and

wherein the multi-quantum barrier layer consists of a plurality of double layers of an $Al_xGa_{1-x}N$ layer and an $In_yGa_{1-y}N$ layer ($0<x<1$, $0<y\leq 1$) [is formed by making the value of x for the $Al_xGa_{1-x}N$ layer of each double layer differ from the value] and wherein the values of x for the $Al_xGa_{1-x}N$ layers of the [other] double layers differ from each other, thereby making [the] energy levels of the multi-quantum barrier [layers] layer differ from each other.

20. (Amended) The nitride semiconductor light emitting device of claim 12, wherein the p-type waveguide layer and the p-type compound semiconductor layer are the same material layer, [however] wherein the doping concentration of the p-type compound semiconductor layer is higher than that of the p-type waveguide layer.